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Grease Lubrication from the Consumers' Point of View

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Where there is grease there is controversy. The inherent complexity of the suspensions of gels which compose grease compounds is probably the cause of the diversity of opinion about this type of lubricant. However, a thorough understanding of the principles of grease lubrication will quickly overcome any prejudices against it.

While grease in some form has been known for centuries as a means of overcoming friction, its manufacture was more of an art than a science until quite recently. (1) The necessity for solving problems of mechanical design has been the instigation of most progress in the science of petroleum lubrication. It is equally true that modern lubricants have made possible the present degree of perfection which mechanical design has attained. Progress in the two fields has been made interdependently.

This paper will not deal with the technical characteristics of lubricant greases but rather with those factors which tend to complicate the problem of intelligent application and control. It is from these complicating factors that the consumer derives his point of view.

Lubrication is today recognized by the producer as an essential part of mechanical design and assembly. He knows that, without this, all his ingenuity and skill are wasted. The less technically minded consumer is still inclined to consider lubrication to be secondary.

One reason for the consumer's attitude is the fact that in most cases the man who buys the lubricant is not the actual user. The consumer is actually not an individual at all but a group of individuals with separate functions. First, there is the purchaser, who probably has little or no immediate contact with mechanical application and who, too often, has but slight idea of the lubrication problem. His interest, as a rule, is financial. Second, is the better instructed engineering and operating maintenance key man who is faced with the solution of various mechanical problems many of which may be recognized as arising from faulty or inadequate lubrication. Third, we have the oiler who is most intimately associated with the lubrication of the plant. The relative standing of each of these, whom we will term collectively, the consumer, is obvious.

Requirements for Low Maintenance Cost

Consumer management is primarily concerned with low maintenance cost. This involves reduction of replacements due to frictional wear, corrosion, mechanical overload, and injury from improper operation. The secondary effects are maintenance labor costs and production time losses.

Since most of the installations in a plant will function fairly well under any sort of lubrication plan which provides a viscous film between opposed moving parts, the great benefits that may be derived from well organized lubrication are overlooked by executives who are otherwise keenly alert to any possible means to economical operations.

The maintenance of most plants is concerned with a very high percentage of machinery more than ten years old. (2) According to a recent census of the metal working industries, over 38% of all equipment is in that class. This includes two newly expanded industries, aircraft and the army and navy arsenals, in which equipment over ten years old amounts to only 2% for the first and 15% for the second. The processing industries run about 45% and the jobbing shops 59%. Included in this figure are many machines double that age and more.

From the consumer's point of view this is highly significant. The most expensive part of any machine is that part which fails most frequently. New machines present little difficulty with their modern engineered design and planned bearing control. The older machines present innumerable problems with their changed clearances, misalignments, upset castings, and other defects due to usage and maintenance repairs with their cumulative imperfections. Many of these conditions are unavoidable in old assemblies which frequently suffer the demands of forced production and operation by mechanically untrained employees. With every mechanical failure that affects industrial production the lubricant is suspect.

Such failure may or may not be due to unsatisfactory lubricants but the only method by which an anlysis can be accomplished is broad consideration of all physical factors pertaining thereto. Properly regarded, lubrication costs cover overall maintenance and include the consideration of sound, vibration, temperature, reclamation, general behavior, etc., which considerations are intimately tied up with anticorrosion friction control, hazards, cleanliness, degreasing technique, assembly, and bearing

selection. It is even true that many lubrication problems could have been cleared up on the drafting board. Only an analysis which takes into consideration all these factors will lead to the selection and proper application of the correct lubricant.

THE SELECTION OF LUBRICANTS

The difficulties which stand in the way of making a simple selection of the lubricant by reading the price list from right to left are; the wide variety of greases and grease compounds on the market; the subtle differences between greases in the same range; the number and complexity of tests no one of which is definitive for a specific application; the variety and complexity of the mechanical factors involved in any single application; and the unreadability of the technical literature insofar as the average consumer is concerned.

There is no question but that some low priced lubricants give entirely satisfactory service under optimum conditions, but, as a rule, the price of a lubricant is a poor basis upon which to judge the economy of maintenance costs. Where low priced greases are available there are but two inferences, first that the inherent quality of the product is such that cost of production is moderate or, secondly, that the quality of some ingredient is sacrificed for cheap production.

A common practice among consumers is to confine all the lubricant purchases to one producer company. In other words, price or preference, and occasionally prejudice, supercede quality as a motive. This applies not only to the ultimate user, but also to the machine manufacturer.

Numerous instances in all your files indicate that the fault lies with the consumer as a result of his ignorance of the basic problem of economical maintenance. In fact many machine manufacturers, some of whom rank high in the industrial field, call for bids on their annual supply of greases to be recommended for use with their machines, and accept material that many of us would find unsatisfactory.

My own interest was aroused in an attempt to clear up a bearing problem on an assembly for which a lubricant was recommended and sold under the name of the machine manufacturer in question. The lubricant was obviously not satisfactory and laboratory tests proved it to be not only inadequate but of inferior quality. In spite of this, it was sold to the user of the machine in handy containers as a special product and at a very profitable price.

Today's high pressure production has taught us nothing if not the fact that the purchase of all products should follow carefully engineered investigation. In the field of lubrication this includes thorough tests of the lubricant and study of operating conditions over an extended period. Although the grease producers try to keep down the ever lengthening list of grease compounds, the conditions under which they act as lubricants are so many and varied that a wide range of grease types is inevitable.

In the broad sense greases are intimate dispersions of soap and oil which, below their melting point, solidify in proportion to the soap content. (3) There are subtle differences in chemical compounding as pertains to production processes which, fortunately or unfortunately, make one particular product preferable if not essential in a specific mechanical operation. Thus the number of greases from which selection must be made is likely to continue expanding.

With the wide range of formulae, the evaluation of each grease requires a complicated procedure. Many of the tests for their control and manufacture are experimental and few tests in themselves contain all the elements required for practical control.

Corrosion data are a good example. Burns (4) has shown that no simple test exists whereby the corrodability of a metal in all its environments can be determined.

Again, most consumers have only a vague idea of what is implied by viscosity. (5) Oils of different grades may have the same viscosity and not be suitable for similar applications. Salesmen emphasize Pennsylvania grades, bright stocks, paraffinic oils, etc., but the naphthenic or asphaltic types, Mid-Continent, and Coastal crudes are all capable of producing high grade lubricants, and when these are applicable, the Pennsylvania crudes of paraffinic type may be quite unsuited.

To engineer the selection of a proper lubricant for a specific application requires consideration of the metallurgical compositions of bearing surfaces, tolerances, clearances which provide for suitable films and their distribution by various means within the pressure areas, to say nothing of temperature control, surface tension, shear stresses, extreme service factors, etc. We might even call attention to catalytic reaction derived through bearing disintegration. In such cases, the acceptance or rejection of a prescribed lubricant depends, not upon the lubricant itself, nor upon the bearing particularly, but upon the operating conditions obtaining. Lead is a familiar example of a metal which serves as an inhibitor under certain conditions and in the same bearing, under different service conditions, it may corrode to such an extent that it cannot be used. (6)

Like most technical problems, the fundamental details are well enough understood by trained lubrication experts, but the technical terminology and peculiar variations which characterize specific requirements are so much jargon to the average consumer. One needs but a glance at the more fundamental literature emanating from the refiners laboratories, the technical societies, and various scientific sources, together with the rapidly growing bibliography to be convinced that the average consumer will be at sea. In addition, the non-technical literature is apt to be so indefinite in character that it lacks value as a guide to lubrication.

Thus we see that the selection or rejection of a specific lubricant is a delicate and frequently precise engineering procedure. We must have standardization if any selection is to be made possible.

Only trouble is in store for those consumers who order grease by the old standard number designations such as "number one" or "number five" grease. This empirical selection can only result in dissatisfaction, and failure brings the usual run of complaints to the door of the producer when the fault may lie entirely with this hit or miss system of specification.

The classification of grease requirements demands a clear conception of the fundamentals of petroleum production, mechanical design and assembly, and practical maintenance. The efforts of the A.S.T.M., N.G.L.I., A.S.L.E., and others toward a closer control is doing much to overcome these difficulties. Such classification will make possible the kind of application imperative for routine lubrication. Once the lubricants are decided upon, the work of the purchasing department is simplified and controlled to the better satisfaction of both producer and consumer. Classification is a necessity and the care and consideration given in preparation and disposition is of utmost importance.

But the consumer should know that the written specification or classification itself is a doubtful criterion unless it is controlled intelligently. Too often the specification is written in the technical design, or mechanical department without due observance of recommendations from competent authorities familiar with the plant operations and technology of lubricants. When specifications of this sort are sent out to the producer it is not a very difficult matter for most refiners to offer products within a specified range, but the variations within that range are such that a product coming

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within but on the low side may be sufficiently different to affect the practical application greatly, and cause it to be less suited than the product under the same specification but on the high side of the demanded range.

These are reasons why specifications are frequently misleading, and must be periodically reviewed. The final solution lies in the consumers' interest in cooperative engineering procedure. (7)

METHODS AND APPLICATION

Equally important with the selection of the lubricant is the correct application of the material chosen, if the consumer is to attain the disiderata of minimum maintenance cost. Grease compounds can be intelligently used only if the peculiarities governing the various applications are understood. Among these applications are: common lubrication of ball, roller, and sleeve bearings, in all their modifications; sealing of clearances for bearing protection; various molding operations, as in brick manufacture; casting of plastic materials; deep-drawing lubrication; extrusion; sealing of steam and other fittings; special mill and railway applications; musical instruments; gun greases, as nitric powder solvents; insoluble pump greases for carrying solvents; grinding compound bases; coolant and cutting compounds; rust prevention and corrosion control; etc. The list may be extended to include high and low temperature instrument greases, cable lubricants, and many more.

For correct grease application, allowance must also be made in the design of the machine to cover bearing assembly, methods of application, accessibility, and hazards. The newer machines take these factors into account to some extent, but many of the older assemblies were designed before industry became as strongly lubrication conscious as it is now.

In addition each plant has inherent characteristics which affect in some degree the lubrication of that industrial unit. The abrasive, glass, food, rubber, and metal industries are examples where the production and maintenance requirements are extremely different. Large corporation plants are really made up of a number of unique units each of which presents distinctive requirements. Each plant and indeed, each department in a plant demands a set-up of its own, the machine shop being as foreign to the rubber mill or furnace or crushing department as certain specialties divisions would be to the die casting or power plant.

Sometimes a plant in one industry will be physically located where it may be affected by a plant in another industry; the bearings in any type of plant may be corroded by chemical fumes from a neighboring plant, or even from another department in the same plant. These are known as zonal conditions and include as uncontrollable a factor as climate. Any of these factors may make it desirable to modify design and application.

There is a grease type specific to each of these applications and a grease designed for one particular use may or may not have characteristics which make it available for another quite different application. Until quite recently, grease was considered a heavy duty lubricant where extreme pressures, low speeds, and control of bearing contamination or oil drip was the problem, but greases have recently invaded the field of high speeds and limited clearances heretofore considered exclusive to oil lubrication (8). The sealing quality of grease may be well known, but the practical hydraulics of this product is not generally understood. (9)

Being a grease enthusiast, I am inclined to the belief that grease manufacturers are modest in their claims for the effectiveness of grease lubrication. Although the dream of an all-purpose lubricant will probably never be realized, I believe that grease approaches the fulfillment of such a lubricant but the factors governing its application demand a degree of originality and creative instinct beyond the capacity of most lubrication men at the present time. The literature now available is not such as to encourage the use of grease along this broader range since it deals mainly with the overall picture of grease along the old preconceived idea of heavy duty.

There are many revolutionary methods in operation today which defy most of the commonly accepted rules for this type of service. The war emergency has compelled maintenance men to contrive unusual methods to offset their inability to obtain standard parts or bearing alloys heretofore deemed essential. While many of the substitutions are considered temporary, it is likely that some of them will remain, since they have proved equal and frequently superior to the original design. Some of these alterations could not have been made if oil lubrication had not been replaced by grease even though the application of grease may have demanded an alteration in the assembly. In many cases the double exigency may prove a blessing in disguise. No doubt many of these changes would have been instigated eventually in any case, as competent creative lubrications engineers became available.

An example of one very important element in lubrication control is the babbitted sleeve bearing. After a very extensive study of this class of bearing service as related to lubrication, I am convinced that there are very few good babbitt installations. There are a number of circumstances which affect the problem to such an extent that both bearing and lubricant may be rendered unserviceable.

1. Babbitt alloys are very unstable chemically and require great care in compounding, melting temperature control, and application.
2. The bond between babbitt bushings and shell must be such that heat radiation will not be reduced. (10)
3. Proper adjustments of fittings and seals, and correct grooving technique are as important as for bronze or any other precision type of bearing. (11)
4. Temperature should be controlled pyrometrically and reliance on the charring of pine sticks should be eliminated if the best results are to be secured.
5. Bearings of high tin alloys are designed to overcome specific chemical reactions and are otherwise of no greater value than properly designed lead base alloys. (12) In many cases they have even proved inferior.

Without the consideration of these and associated factors, it is impossible to obtain any degree of satisfactory service from the lubricant. Given optimum bearing service conditions, greases meet the lubrication requirement if properly applied.

One of the most serious difficulties in the babbitting procedure is that of preparing the casting properly for babbitting, and the cleaning and degreasing procedures are among the most potent in this respect. Recent studies cover this quite thoroughly. (13) This misuse of the degreaser is not the fault of the plant personnel because there are so many technical details involved that, even though practical operation is good, the degreasing may be ineffectual. In many plants the degreaser is not universally adaptable to all the operations required.

Solvents and cleaners vary in quality and degree of effectiveness and the removal of residual insoluble and soluble debris requires methods usually overlooked. The temperature and vapor levels in degreasers are closely related but are frequently adjusted improperly and so cause costly waste of solvents as well as creating hazardous conditions which should not exist. When the operation is properly controlled, the hazards are practically negligible. The ultimate objective is chemical cleanliness, and many failures blamed on grease products are due to this misunderstood operation. In fact, the effect of lubricants can be disastrous where the cleaning is not complete (14) and misuse of the degreaser may write a considerable item in maintenance expense.

These are examples of the angles presented to lubrication servicing of any plant where the effort is toward efficient and economical maintenance.

Ways must be found to overcome the confusion resulting from the variety of application and the multiplicity of special lubricants recommended by the manufacturers, added to the considerable variety of special grades. Every effort must be taken to make the work of servicing the machine as simple and foolproof as possible. Beyond the mechanical fittings, centralized systems, automatic and semi-automatic controls and methods of administration, the code system seems to meet a very important demand. This involves a color guide with fittings, guns, cans, and other accessories all marked to conform to a given lubricant use for that particular set-up. (15) This system has nothing to do with the identification of lubricant characteristics and is intended to simplify the servicing of a particular point on the machine. Under such a system, the unskilled laborer cannot fail to use the right lubricant, though it cannot control the quantity used nor the cleanliness of the product. With suitable supervision it gives a fair degree of desired results.

The installation of a system of this kind is not difficult and does not entail any great expense. There are a number on the market and the American Standards Association has attempted to devise a universal method which could conceivably be extended beyond the point of mere servicing. The most undesirable aspect in my opinion, is that a few of the suggested systems are the property of certain producers who limit their use to the contracting consumer. I think that this feature will eventually wear itself out. The quality of the lubricant offered seems to me to be the best selling argument, and codes are not satisfactorily confined to one contracting consumer except in very small plants with limited demands. Most plants have the materials for the development of a code system but lack the knowledge necessary for installation.

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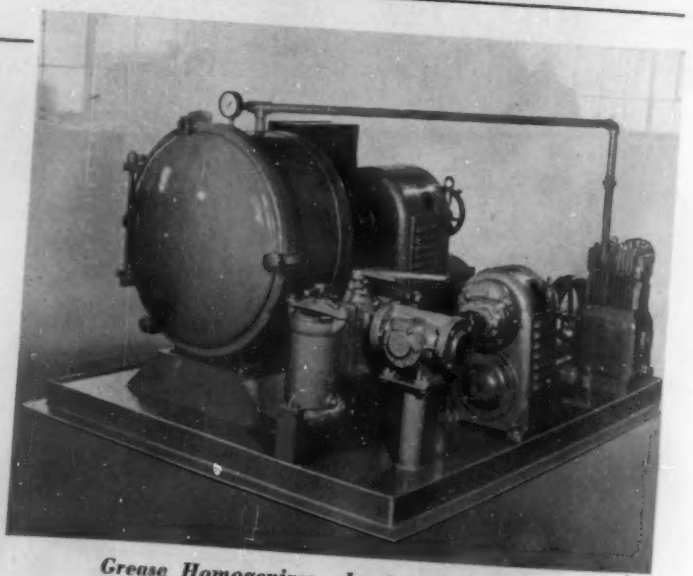

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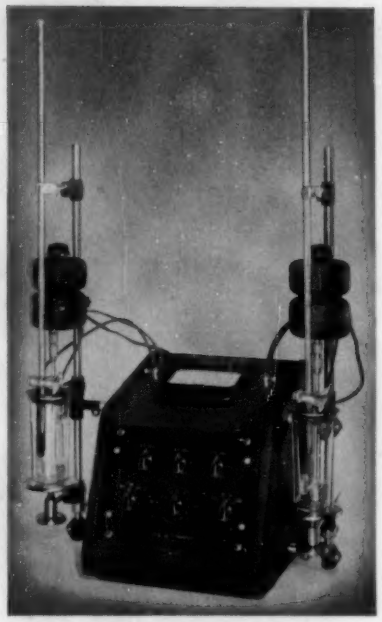

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